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RSS technology has improved, but can it be made less expensive?

RMOTC takes on increasingly important role in low-cost RSS development.

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Rotary Steerable Systems (RSS) have exploded onto the drilling scene over the last 10 years. The Rocky Mountain Oilfield Testing Center (RMOTC), operated by the Department of Energy at Naval Petroleum Reserve No. 3 (NPR-3), is playing an important role in RSS technology development with its real-world testing environment.

INTRODUCTION

Over the past several years, RMOTC has seen an upsurge in RSS testing. This increase appears to be a direct reflection of trends in worldwide drilling activity and technology development. RMOTC's facilities allow partners the opportunity to operate constantly during testing, allowing for continuous periods of time to be placed on seals, bearings, motor housings, etc. on an actual drilling rig. The field test site, located on Teapot Dome oil field, also offers a range of rock compositions for RSS testing to take place. There are currently four producing zones at Teapot Dome: Shannon, 500 ft; Niobrara Shale, 2,000 ft; Second Wall Creek, 3,000 ft; and Tensleep, 5,500 ft.

RSS TECHNOLOGY

RSS technology is extremely complex, involving state-of-the-art electronics, hydraulic systems, turbines and measurement-while-drilling systems. Based on feedback received at the 2007 Rotary Steerables Forum, hosted by the International Association of Directional Drillers, reliability testing is a major focus for the industry.

RMOTC has partnered with companies testing both push-the-bit and point-the-bit RSS technology. One of RMOTC's clients, PathFinder, has a well-developed system that can be converted from push-the-bit to point-the-bit with the addition of a near-bit stabilizer. The near-bit stabilizer acts as a fulcrum to point the bit in a certain direction.

RMOTC partners have had varying degrees of success with their low-cost rotary steerable tests at NPR-3. To date, RSS tests have reached total vertical depths as far as 2,100 ft and total measured depths of 3,972 ft, Fig. 1.

WHY RSS?

One advantage of RSS is in the ROP of the formations drilled. During conventional directional drilling, the drillstring usually does not rotate for a period of time (i.e., slide drilling with a mud motor). During this period, penetrations rates are significantly slower than when rotating the drillstring. Weight transfer to the drillbit can be erratic, resulting in unwanted spudding of the drillbit and downhole vibrations.

After a period of slide drilling, the drillstring is rotated for a length of time to drill additional holes and clean cuttings out of the hole. During this rotational time, ROP increases significantly, often by a factor of two or three. The combination of slide and rotation results in a wellbore that is tortuous or enlarged. This combination of drilling can also result in doglegs in the well or abrupt, unwanted changes in inclination and/or direction. Since the drillstring is constantly rotating, RSS reduces dogleg severity.

The net effects of RSS are higher ROP, improved hole cleaning, reduced wellbore tortuosity and more efficient directional control. There are other benefits such as lower incidents of stuck pipe and smoother boreholes resulting in improved casing running, cementing and gravel packing. RSS have much higher daily rental rates and higher lost-in-hole costs—which can run close to $1 million[1]—but these factors are mitigated offshore, both economically and technically, by the advantages of RSS.

In a recent SPE paper, ExxonMobil states, "RSS are currently being deployed in approximately 5% of our daily rig operations."[2] The high-cost, reliable, thoroughly tested RSS is well established in the offshore market; however, ExxonMobil identifies the need for, and has committed to the development of, a low-cost RSS that can be justified in 35% of its direction-

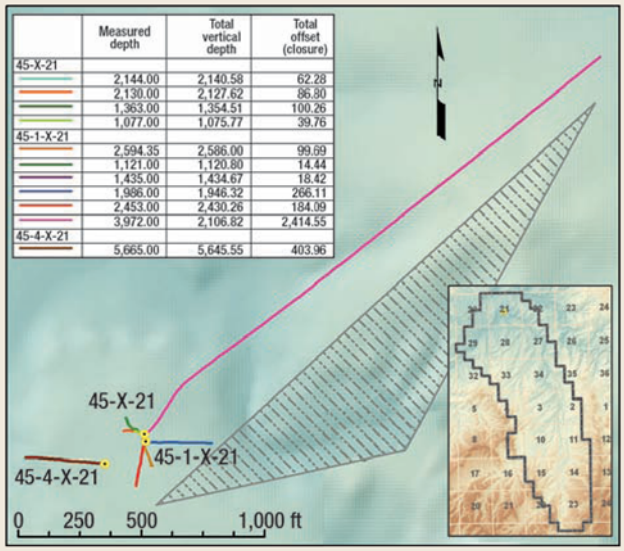

Fig. 1. Paths of the RSS projects at Teapot Dome oil field.

ally drilled wells, including both onshore and offshore operations.

ExxonMobil's commitment to develop low-cost RSS has become a primary driver in the industry. In a subsequent paper, ExxonMobil identifies Noble Corp., a recent RMOTC partner, as one of the two vendors it selected to develop low-cost RSS.[3] Based on ExxonMobil and Noble's results, estimated savings with successful application of low-cost RSS are forecasted to be about 30% compared with commercial tools, and where it is prohibitive to use commercial tools, estimated savings are forecast to be about 30–60% compared with conventional steerable tools.

Other RMOTC test partners have also published papers related to cost-effective RSS. In its paper, PathFinder states, "The RSS has been designed to handle the technical requirements of the most challenging wells, but also to be economical for use in low-cost wells."[4]

RSS IN THE MARKETPLACE

The natural question would be, "Why isn't rotary steerable technology used everywhere in lieu of conventional directional drilling?" Large capital investments were made in R&D to bring the first systems to the market, resulting in high rental day rates, often as high as the day rates of the rigs with lost-in-hole costs higher than total well cost.

Broader application in domestic and international mature oil fields on land will require another step change in cost to fit the application somewhere above conventional directional drilling, but below current generation RSS.

CONCLUSION

The RSS industry is making strides in development with expanding horizons and applications. Conventional, directional drilling will continue to dominate the low-end market as RSS dominates the high-end market. The possible drilling market for RSS is extensive both onshore and offshore if the technology cost is decreased and reliability improved. The main beneficiary of low-cost RSS development will be in the land-based, mature oilfield market, in particular, onshore US. Development will likely continue for a number of years until the systems are designed, fabricated, lab tested and finally, field tested at RMOTC or other similar facilities. **WO**

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